

Coronal magnetic field measurement using CME-driven shock observations

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Collisionless shocks form ahead of coronal mass ejections (CMEs) when the CME speed exceeds the Alfvén speed of the ambient plasma in the corona and interplanetary medium. The shock stands at a distance from the CME flux rope that depends on the shock Mach number, the geometry of the driver, and the adiabatic index. While the shock ahead of the CME has been observed for a long time in the in situ data, it has been identified recently near the Sun in the coronagraphic and EUV images. Unlike in situ observations, the imaging observations are two dimensional, so one can better discern the CME-shock relationship near the Sun. Gopalswamy and Yashiro (2011) demonstrated that the coronal magnetic field can be derived from the shock standoff distance measured in coronagraphic images. The method involves measuring the standoff distance, the radius of curvature of the flux rope, and assuming the value of the adiabatic index and deriving the Alfvénic Mach number. The next step is to derive the Alfvénic Mach number from the measured shock speed and an estimate of the local solar wind speed. The final step involves deriving the magnetic field from the Alfvén speed by measuring the local plasma density either from coronagraphic (polarized brightness) images (Gopalswamy and Yashiro 2011) or from the band-splitting of type II radio bursts (Gopalswamy et al., 2011). In this paper, we derive the combined magnetic field profile from near the Sun to the edge of the LASCO field of view (1.5 to 30 solar radii) and compare it with the current model profiles.